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a PREVIEW

EFFECTS OF BIOLOGICAL & CHEMICAL WEAPONS

U.S. ARMY CHEMICAL CORPS

DOWNGRADED AT 12 YEAR
INTERVALS: NOT AUTOMATICALLY
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(C) Introduction

This is a preview of the effects of some biological and chemical weapons.

Such a weapon consists of an agent-munition combination coupled with a suitable delivery device. The physiological effects it produces depend on the agent it contains.

For the purpose of this Preview, several agents have been selected to illustrate the various kinds of effects which can be produced. Two kinds of munitions are considered—spray tanks and bomblets. Delivery is by the following—the Honest John Rocket, the Sergeant Missile, Drones, and Tactical Aircraft.

The quantitative effects of some of the weapons discussed in this report are projections based on data partly derived from incomplete experiments. The descriptions of the characteristics of these weapons are the best presently available. However, they may not correspond exactly with the definitive descriptions which would result from further research.

(U) Biological and Chemical Weapons

Only a partial list of the distinguishing characteristics of biological and chemical weapons is presented in the following paragraphs. However, it is hoped that what has been suggested here will permit those expert in military theory to examine the field with more precision and to detail its implications, both offensive and defensive.

Biological and chemical weapons are basically area weapons. This label is used in the sense that the effect of such a weapon does not diminish rapidly with the distance from the point of origin.

The classic defense against weapons of increasing power — dispersal of forces — is not appropriate with these weapons.

Some of these weapons are capable of producing their effects over very large areas. Consequently, the necessity for pin-point reconnaisance is greatly reduced.

An attack with a biological or chemical weapon does not require precise location of the enemy.

Adequate preparations make defense against these weapons possible.

However, the standard defenses used against explosive weapons are very ineffective.

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However, the standard defenses used against explosive weapons are very ineffective.

The agents released from these weapons are capable of penetrating ordinary entrenchments, fortifications, and buildings. In the extreme case it could be pictured that the use of biological and chemical weapons is equivalent to conducting operations on a featureless plain, where concealment and protection by the usual devices are not possible. The classic cases of Cassino, Leningrad, and Tarawa lend themselves to interesting studies as to possible results with these weapons.

> Generally, on such a featureless plain "hard" targets are not "hard" to biological and chemical weapons.

The principle of maneuver is often an overriding operational consideration. The effect on tactics and strategy that would result from any diminution of maneuverability deserves close attention. For example, forces "frozen" into position by incapacitating biological and chemical weapons are far more vulnerable to other means of attack and much easier to bring under attack by superior mass than if these weapons were not used.

> Biological and chemical weapons can drastically reduce the ability of forces to maneuver. This drastic reduction will occur even when the effect on troops is to produce only rather mild incapacitation.

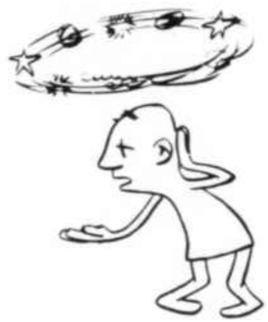
Nonlethal weapons — those that incapacitate without killing — can be used on targets where enemy and friendly personnel are intermingled. The political consequences which might completely prohibit the use of lethal weapons have little bearing on the use of nonlethal weapons.

> Truly nonlethal weapons can be found only among the biological and chemical weapons. These weapons stand out because of their capabilities for producing controlled temporary incapacitation — incapacitation controlled in severity, onset time, and duration — a quality not shared by any other weapon.

(C) Agents

Biological and chemical agents gain entry into the body through various portals, the more important of which are the respiratory tract, the eyes, and the skin. Their actions are sometimes largely local, as in the case of agent CS which acts primarily on the respiratory tract and the eyes, and sometimes largely systemic, as in the case of agent X and biological agents in general. Collectively, the agents elicit a broad spectrum of effects ranging from mild discomfort, through temporary illness of varying severity, to complete irreversible disability and death. Brief descriptions of the agents included in this Pre[illegible] follow.

The nonlethal agent CS is a synthetic chemical compound which, within a minute after exposure, rapidly and violently irritates the eyes, nose, and respiratory tract. These irritations are accompanied by copious tears, involuntary eye closure, pains in the chest, choking, and violent coughing. The affected personnel are incapable of effective military action or even self-defense. Recovery is complete and spontaneous.

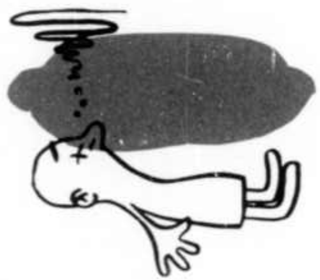


The hypothetical, nonlethal agent ALPHA is a synthetic chemical compound designed to be disseminated as an inhalable aerosol. In addition to eliciting a variety of relatively minor physiological effects, doses of military interest produce, in about six hours, loss of muscular coordination (which leads to staggering and stumbling), mental confusion, and hallucinations. Recovery is complete and spontaneous in about three to four days.

The nonlethal agent NU is a viral microorganism which causes disease within two to six days after respiratory exposure. The major symptoms are headache, muscular pains, fever, lethargy, and gastrointestinal and visual disturbances. The agent is highly infectious for man, and the disease is incapacitating but practically nonfatal. About 3% of infected personnel may die.

The nonlethal agent OU is a rickettsial microorganism which causes a mild, essentially nonfatal disease. The disease starts within 9 to 18 days following respiratory exposure and lasts from two to four weeks. The major symptoms are fever, nausea, severe headache, muscular pains, debility, and dry cough. Chest pain is a common complaint. Exposed personnel will probably not be completely incapacitated, but their ability to march or perform tasks requiring sustained effort will be very significantly reduced. About 1% of the infected personnel may die.

The nonlethal agent UC is a toxic chemical substance produced by certain bacteria. This agent acts in an hour or less after respiratory exposure. It produces nausea, vomiting, abdominal cramps, diarrhea, and general debility. Exposed personnel might be able to fight back if under immediate direct attack, but they could not march or perform military duties requiring sustained effort. Recovery is complete and spontaneous.



The lethal agent GB is a rapid-acting nerve gas designed to produce its effects primarily through inhalation. Its actions are multiple and involve the eye, the gastrointestinal tract, and the respiratory, neuromuscular, and central nervous systems. Death results primarily from respiratory paralysis and occurs within a few minutes after exposure to doses of practical military interest. The majority of exposed subjects will die, and those who do not will be incapacitated for one day or longer depending on the dose received. Very severely affected subjects exhibit convulsions, collapse, and paralysis, and will be incapacitated for three to about ten days.

The lethal agent VX is another nerve gas, but, unlike GB, it can produce its effects through skin penetration, thus providing effectiveness against masked personnel. It is also effective through clothing. The actions are essentially as described above for GB except that the onset time is much longer. Doses of practical military interest will kill the majority of exposed subjects within about two to seven hours, and most of those not killed will be incapacitated essentially as described above for GB.

The hypothetical, lethal agent BETA is a bacterial microorganism pathogenic to man by inhalation or by the bite of infected fleas. The disease is highly infectious and rapidly overwhelming. It is also highly contagious and can readily assume epidemic proportions. Illness begins abruptly within two to four days with chills, headache, malaise, and a fever of 102 to 105°F within a day of onset. Cough, cyanosis, prostration, rapid breathing, delerium, and coma are commonly present. About 90% of the infected persons will die in two to five days if untreated, and survivors will be incapacitated for about 10 to 20 days.

The lethal agent N is a sporulating bacterial microorganism which is highly pathogenic to man by the respiratory route. It is very stable and thus presents a persistent hazard. Illness begins in about three to five days after exposure and death results in one to six days later. Infected persons usually feel ill only shortly before death when they experience general malaise, fever, headache, cough, pain in the chest, and difficult breathing. Cyanosis develops and the individual becomes weak and semiconscious and expires shortly thereafter. About 90% of those infected by the respiratory route will die, and survivors will be incapacitated for about three to five weeks.

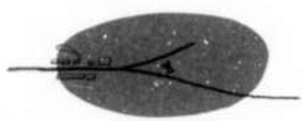
The biological agent UL is a bacterial microorganism which causes disease within three to five days after exposure. The symptoms are variable, but extreme weakness and high fever always occur. Inflammation of the eyes and respiratory tract is common. Infected personnel will be incapacitated for a period of many days to weeks, and about 30% will die if not treated.

The lethal agent X is a chemical substance formed by certain bacteria. It is the most potent toxin known and acts on nerve and brain tissue within 4 to 72 hours to produce nausea, vomiting, drooping eyelids, blurred vision, paralysis of the throat, and a progressive muscular weakness resembling paralysis. About 90% of the persons may be expected to die following respiratory exposure. The deaths will occur over one to seven days, and survivors will be incapacitated for three weeks to six months.

(S) Delivery

Delivery vehicles considered in this Preview include the Honest John Rocket, the Sergeant Missile, Drones, and Tactical Aircraft. Collectively they provide wide variation in agent payload, range of operation, and effective area coverage.

The Honest John Rocket and the Sergeant Missile carry the agent fill only in bomblets. These are contained in suitable warheads which can be opened at any desired altitude. The bomblets disperse during descent and thus release agent at ground level at multiple points scattered over the impact area. The more fundamental differences between the Rocket and the Missile are summarized below. Most importantly, they differ in maximum effective range. In consonance with its much greater range, the Missile is equipped with an inertial guidance mechanism.



	Honest John Rocket	*Sergeant Missile*
Payloads:		
E130R2 (CW) Bomblets	356	327
E134 (BW) Bomblets	740	707
Nominal Maximum Range	40 kilometers	140 kilometers
Design Accuracy (CEP at maximum range)	180 meters	300 meters

The Drones carry agent fill either in bulk form in expendable tanks or in bomblets contained in pods. The former releases agent in the form of elevated line spray which may be either continuous or discontinuous, as desired. The bomblets release agent at multiple points on the ground, and the points may be distributed in a line or scattered over an area, as desired, depending upon the method and altitude of bomblet release.

Two Drones are considered. The AN/USD-2 is controlled by line-of-sight or pre-programed guidance and is designed for tactical employment at Division level as a close support weapon. The AN/USD-5 is controlled by line-of-sight or inertial guidance systems and is equipped with automatic terrain avoidance radar to permit relatively low-level flight. It can deliver a much larger quantity of agent over more distant areas. Both Drones are equipped to permit on-command and/or programed release of weapon or agent and also to permit drone recovery. The more important operational characteristics of the two drones are summarized below.

	AN/USD-2	AN/USD-5
Payload, Maximum		
(bulk agent fill, lb)	210	3,200
(bulk agent fill, gal/ft^3)	26.5/3.54	400/53.5
Range*		
(nautical miles)	225	240 - 2,000
Speed		
(min./max.)	110/300 knots	Mach=.3/.75
Altitude		
(min./max., ft)	250/20,000	250/55,000
Accuracy		
(CEP, meters)	30**	30** - 1,000

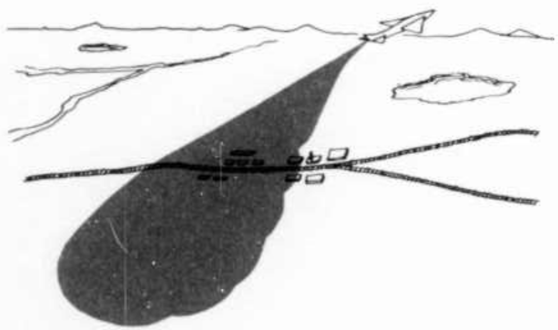
*Maximum range depends on the payload carried, flight altitude and speed.

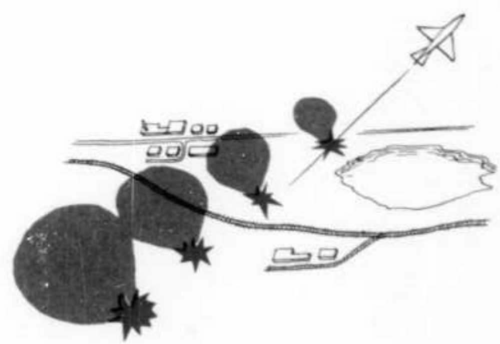
**With ground-based guidance.

Tactical Aircraft delivery, as considered in this Preview, involves utilization of the Aero 14B and the Aero 2A Spray Tanks, each of which gives rise to elevated line sources of agent. Both tanks can be jettisoned.

The Aero 14B is designed for the dissemination of liquid agent fill. Its gross capacity is 91.6 U.S. gallons, and the fill is expelled by means of a self-contained source of nitrogen under high pressure. The pilot can select, in flight, any one of three preset agent fill flow rates.

The Aero 2A is designed for the dissemination of dry agent fill. It has a capacity of about 10 cubic feet, and the fill is expelled with the aid of paddles and ram air. Desired agent fill flow rates can be preset by means of discharge orifices of various sizes; but, unlike the Aero 14B, this tank does not permit selecting the flow rate in flight.





(U) Quantitative Effects

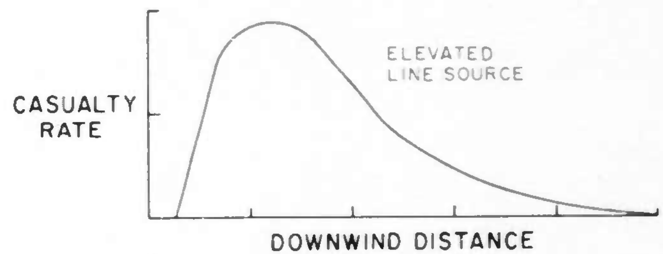
The quantitative effects of any biological or chemical weapon depend upon a number of variables. For example, the shape and size of the area over which casualties are produced depend on:

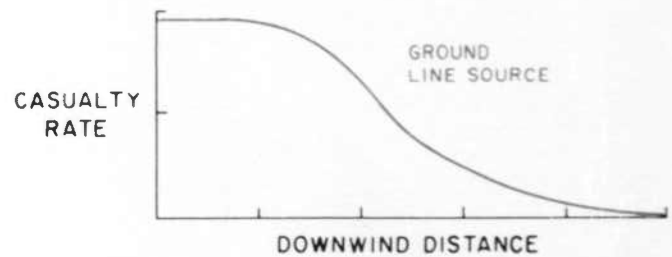
1. the *agent* used,
2. *how much* agent is released at the source,
3. the *altitude* at which agent is released,
4. the *speed* of the vehicle during agent release,
5. the characteristics of the *disseminating device*,
6. the *meteorology* over the target area,
7. the *terrain* and *forestation* of the target area, and
8. the *degree of protection* of the target population.

The effects of these variables are not independent.

For line sources, the general ways in which casualty rates vary with downwind distances from the source line are illustrated by the following curves. In the case of an elevated line source, casualties first occur some distance downwind from the line of release, rise sharply to a maximum, and fall off gradually. In the case of a ground line source, however, casualties are a maximum at the line of release. The shape and scale of the curves are governed by the variables listed above.

For multiple point sources produced by weapons impacting on a target area, casualties are produced more or less simultaneously within the total impact area. The expected fraction of the population within the total impact area which will become casualties can be estimated. Additional casualties occur downwind of the impact area, but this is commonly treated as a bonus effect.



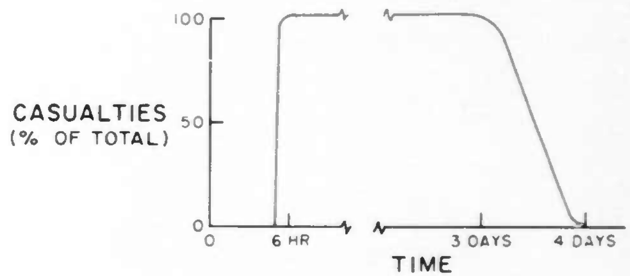


(C) Time Factors

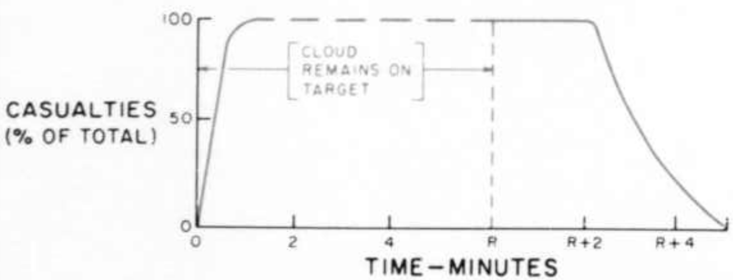
The choice of agent determines both the rapidity with which incapacitation occurs and its duration. As a result, it is possible by selection of agent to incapacitate enemy personnel for the time prescribed by the military situation.

The casualties produced by any attack are distributed in time, and the percentage of the total casualties in existence at any particular time is often less than the total percentage. The following curves show the percentages of the total casualties as a function of time after exposure to each of the agents.

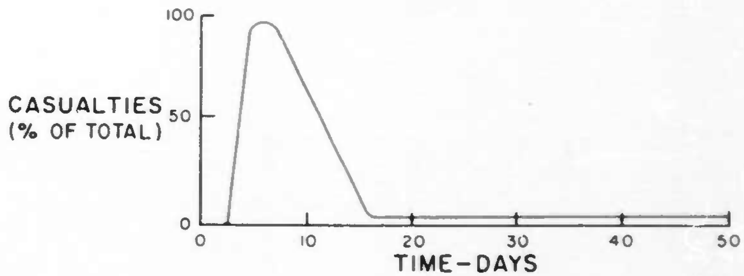
ALPHA — nonlethal



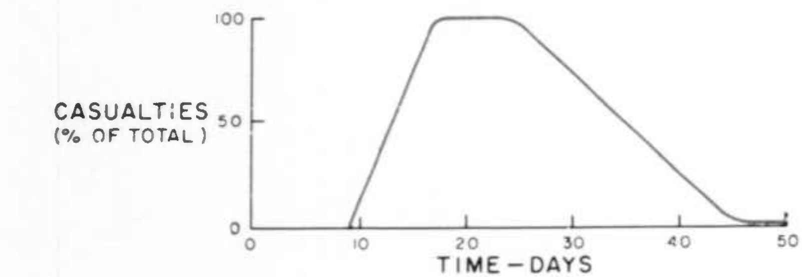
CS — nonlethal



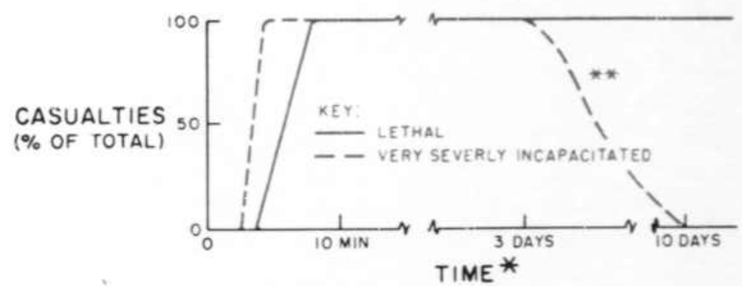
NU — nonlethal



OU — nonlethal



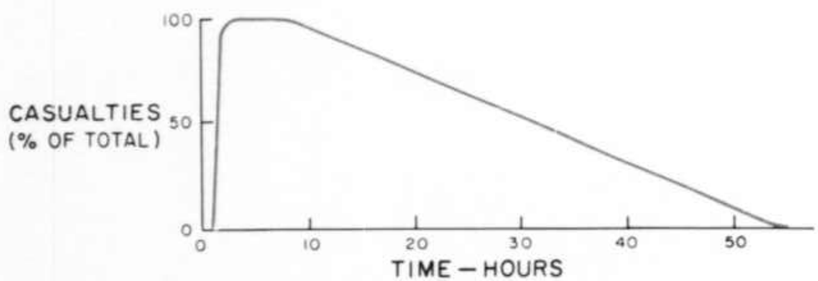
GB — lethal



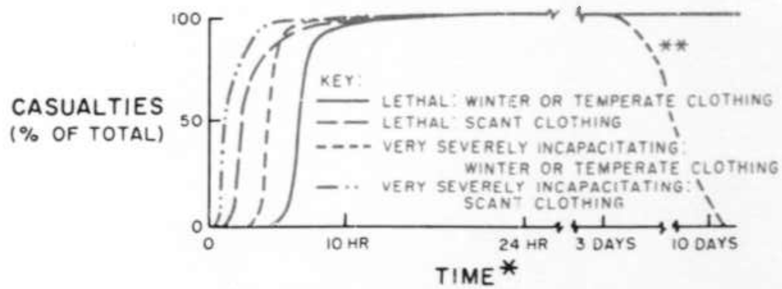
* FOR ONE MEDIAN LETHAL DOSE ACCUMULATED OVER A TWO-MINUTE PERIOD.

** QUANTITATIVE RECOVORY RATE IS UNCERTAIN.

UC — nonlethal



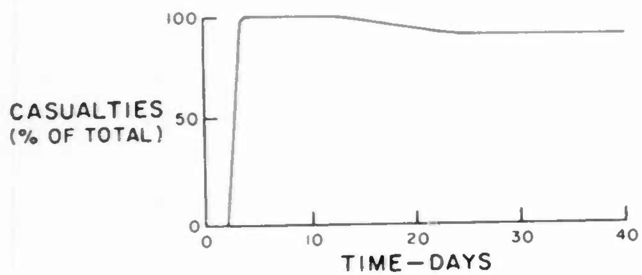
VX — lethal



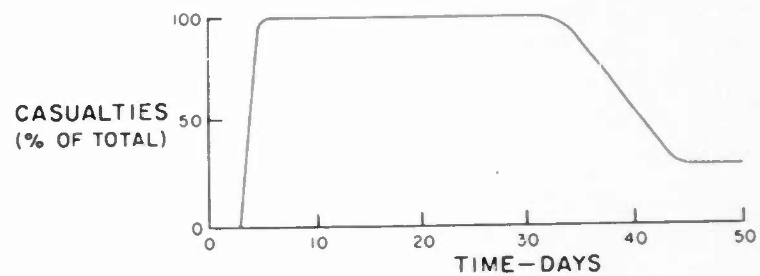
* AVERAGE FOR 1 TO 10 MEDIAN LETHAL DOSES

** QUANTITATIVE RECOVERY RATE IS UNCERTAIN

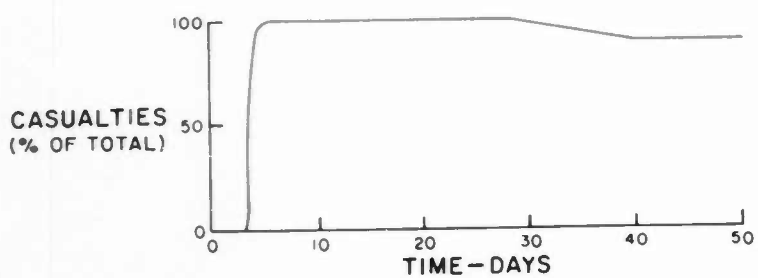
BETA — lethal



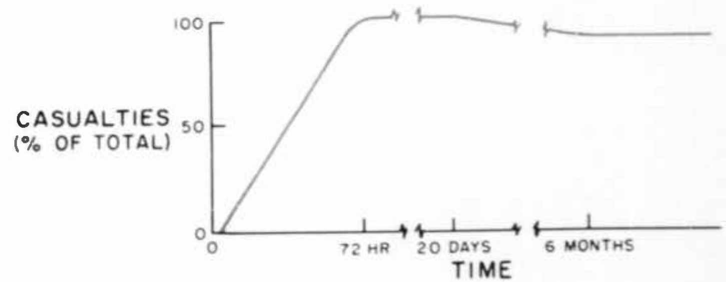
UL — 30% lethal



N — lethal



X — lethal



(U) Targets

Biological and chemical weapons present intriguing potential for effective use on targets against which the employment of conventional and/or nuclear weapons is either (a) inadvisable from a political, economic, or sociological viewpoint or (b) of questionable advantage from a military viewpoint.

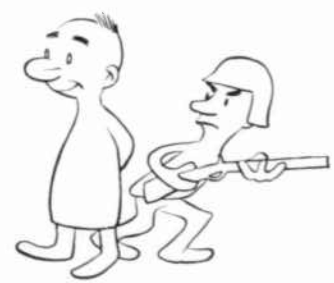
The prominent example of the former type of target is the so-called MIXED TARGETS — target areas in which enemy troops are so intimately intermingled with friendly troops or civilians that the enemy cannot be attacked with conventional or nuclear weapons without simultaneously wreaking unwanted havoc on the others. Such targets are frequently encountered in general warfare and are commonly characteristic of limited or peripheral warfare.

Prominent examples of the latter type of target include:

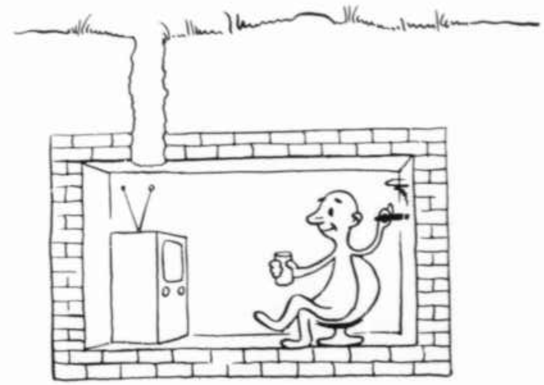
HARD TARGETS — typified primarily by fortifications and other strong points, and, to a lesser degree, by dug-in troops.

DISPERSED TARGETS — typified by targets common among field armies built on the Pentana principle, and especially characteristic of the operations of guerrilla and irregular forces encountered in limited or peripheral warfare.

LINEAR TARGETS — typified by the usual operations associated with moving troops in which precise target acquisition is often poor.

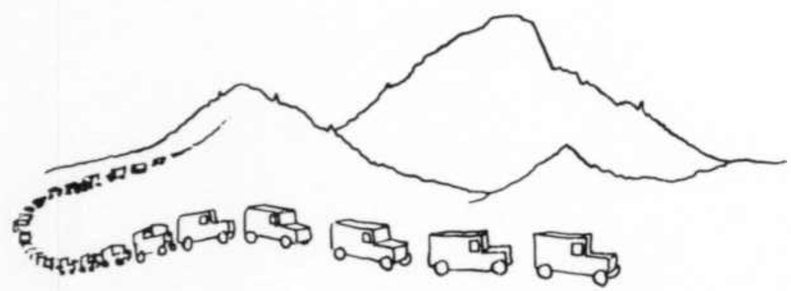


Mixed



Hard

Dispersed



Linear

The more important properties of biological and chemical weapons which render them particularly useful against targets such as the above may be summarized as follows:

1—They permit making a selection from among a broad spectrum of physiological effects ranging from mildly incapacitating to lethal.

2—They vary among themselves with respect to the time required to produce their effects and to the duration of their effects, thus providing flexibility in weapons selection to fit the timetables of military operations.

3—They can be selected to produce casualties who will recover spontaneously with low probability of lingering or permanent disability.

4—They permit the employment of protective devices and procedures which will minimize the production of casualties among friendly forces.

5—They produce casualties over large areas without simultaneously causing physical destruction of structures and materiel.

Because of their characteristics, biological and chemical weapons warrant consideration for possible concomitant use with conventional and nuclear weapons to enhance casualty production.

(S) Defense

As with other weapons, adequate defense against biological and chemical weapons requires both pre- and post-exposure protective measures. Pre-exposure measures include physical gear (e.g., protective masks, special protective clothing, hoods, and shelters) and preventive medications (e.g., vaccines and other preparations designed to confer immunity or prophylaxis). Post-exposure measures include curative medications and decontamination techniques.

Protective masks protect completely against those agents which are effective by way of the respiratory, oral, or ocular routes, *provided* that they fit properly and are donned early enough.

Special *protective clothing*, including hoods, protect against those agents which act through the skin. However, such gear greatly *reduces the functional efficiency* of the wearer, and it *must remain intact* if it is to provide continuous protection.

Preventive medication provides the best conceivable protection against biological and chemical agents. Effective vaccines have been produced, some only on an experimental basis, for certain agents such as OU, UL, N, X, BETA, and UC. Short term chemoprophylaxis also appears probable for nerve gases. However, *much remains to be accomplished* if this kind of defense is to be maximally effective on a military scale.

Curative medication, e.g., antibiotics to combat bacterial and rickettsial infections, and atropine-oxime combinations to counteract nerve gases, will effect significant reductions in lethality and in durations of incapacitation. However, the effectiveness of such defense is predicated on the availability and proper administration of the medicaments, and these factors *impose impressive problems* in combat situations.

Decontamination techniques suitable for body, clothing, equipment, and small areas have been developed, but the application of these techniques to combat situations *presents severe logistical problems* and very materially *reduces the military effectiveness* of combat forces.

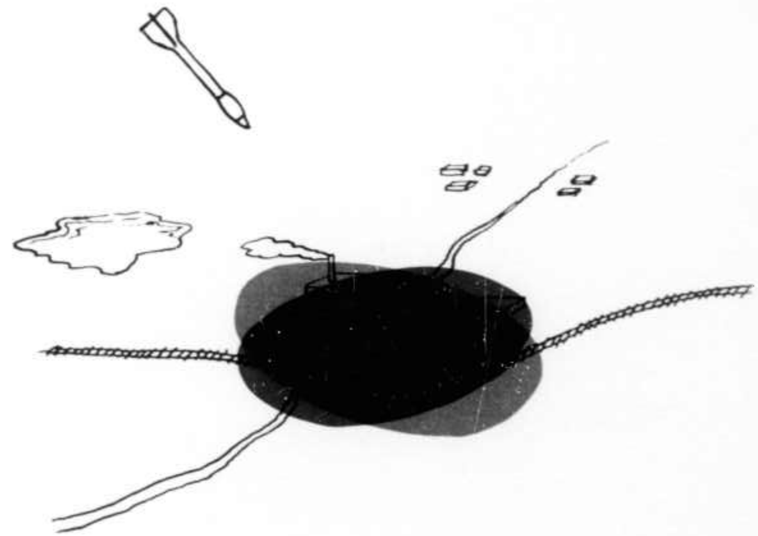
The ability to detect a biological or chemical agent is important primarily as it may prompt inauguration of defense operations. Detect-alarm systems sufficiently sensitive to *prevent* exposure have not yet been developed for practical use in the field. Some systems exist which are sufficiently sensitive to permit early institution of therapeutic measures *following* exposure.

Both the U.S. and the U.S.S.R. are conducting research in the broad area of defense against these weapons. Each may be expected to achieve impressive military defense postures by the mid-sixties. Intelligence estimates, however, indicate that the U.S.S.R. posture will be superior. Some of the other major nations will probably have developed protective devices and techniques to varying degrees, but backward nations and most civilians everywhere will be highly vulnerable.

(C) Area Coverage and Typical Targets

Biological and chemical weapons vary enormously with respect to their potential for yielding area coverages of agent sufficient to produce militarily significant percentages of casualties. Roughly, the variation in such area coverage is from small fractions of a square kilometer, such as in the case of the AN/USD-2 drone loaded CS, GB, VX, ALPHA, UC, or X, to tens of thousands of square kilometers, such as in the case of the AN/USD-5 drone loaded N, NU, OU, UL, or BETA.

With these limitations in mind, the following information is provided as a frame of reference. Examples are given of types of targets over which the indicated biological and chemical weapons may be expected to be useful. By "useful" is meant that practical and feasible weapon expenditure will yield 30% or more casualties among the target population. The size and shape of target areas depend on the location and types of warfare under consideration. Most of the typical target areas represented below are those commonly used in warfare studies.



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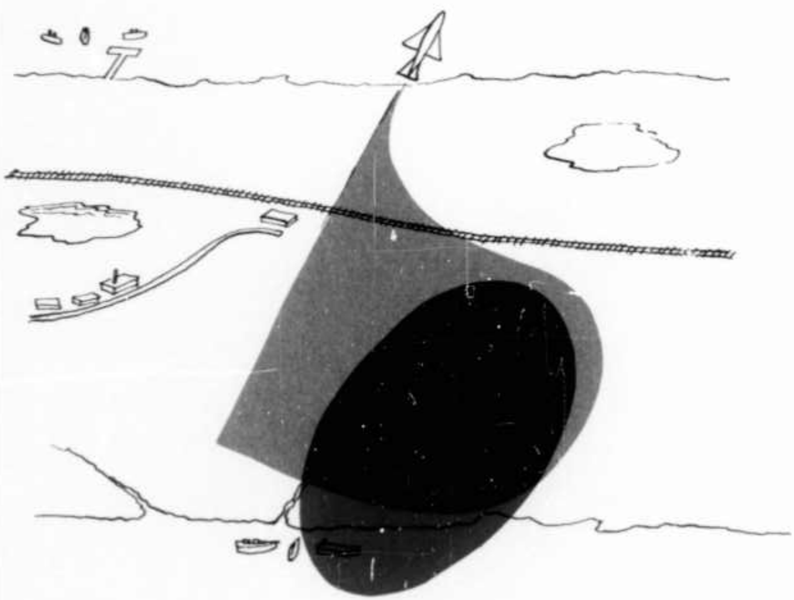

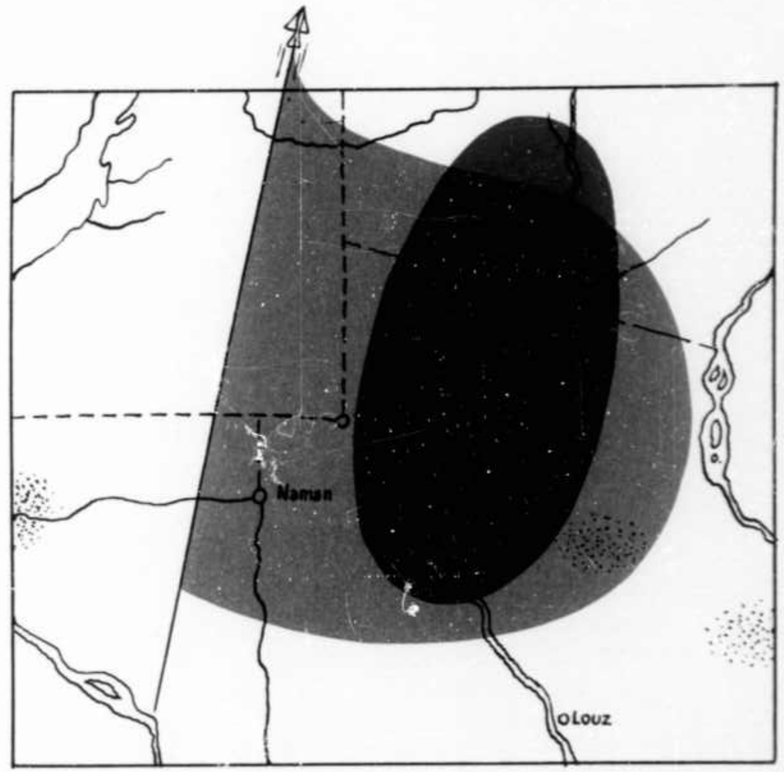

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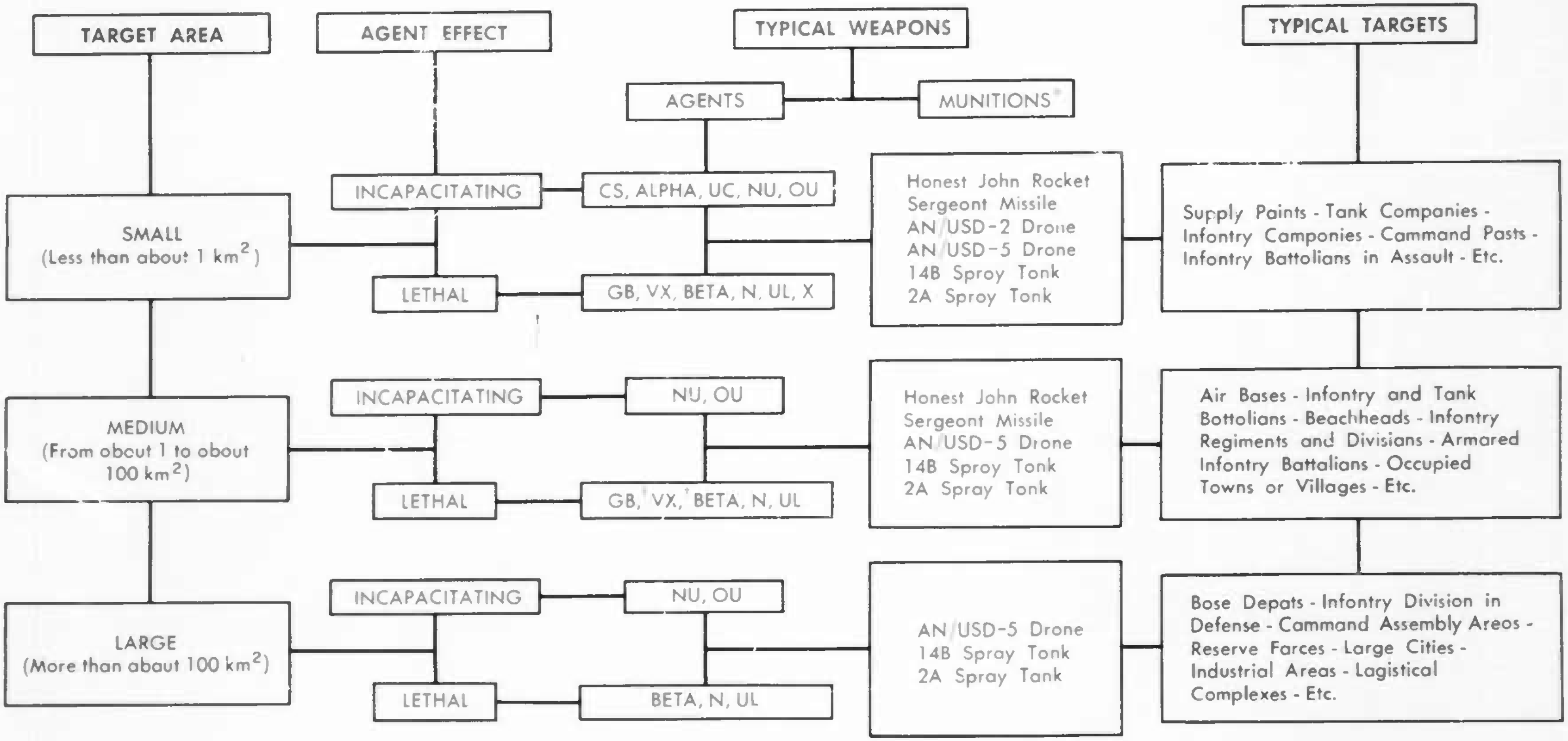

† Maximum area coverage is about 10 km²

*NOTE: Area coverage alone does not prescribe completely the munition of choice for a specific target. The distance to target and the characteristics of the agent carried must also be considered.

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